Multi-Band Radiometric Imager Utilizing Uncooled Microbolometer Arrays with Piezo Backscan for Earth Observation Mission Applications

Completed Technology Project (2016 - 2019)

Project Introduction

DRS Technologies takes pleasure in presenting this Multi-Band Uncooled Radiometer Imager (MURI) proposal for the Instrument Incubator Program (IIP) that will provide improved radiometric imaging performance, substantially reduce the cost, complexity, and development time for future Polar Orbiting earth observation imaging radiometer sensors. Our proposed solution leverages conventional, low cost uncooled microbolometers with a compact piezo driven backscan and our patented TCOMP algorithms for improved radiometric accuracy and stability. Our solution eliminates the need for cryogenic cooling, solves the problem of image smear associated with the bolometers relatively long time constant, while simultaneously ensuring low NEDT. The objective of the DRS proposed MURI program is to demonstrate that modern, low cost, large area microbolometer FPAs can be utilized to provide narrow band radiometrically accurate imaging in 8 LWIR bands for Earth Science applications. The potential earth science applications for this technology are Land Surface Climatology, measurement of soil moisture content, measurement of Ecosystem Dynamics, Volcano Monitoring, Hazard monitoring, Geology and Soils. On the IIP Program, DRS plans to design, build, test and demonstrate an uncooled microbolometer breadboard sensor hardware for earth observation. Our Science partner, Rochester Institute of Technology (RIT), will support the airborne data collects, radiometric data analysis and comparison to LANDSAT 8 for a “truth reference” and the science implementation aspect of the instrument data collects. DRS/RIT will collect airborne data for three primary applications in 8 spectral bands. The first will assess initial data quality and calibration with known targets deployed, the second will demonstrate scientific products available over vegetative and urban environments, while the third will demonstrate important aspects of volcano monitoring. One key technological solution is the use of a piezo back-scan stage located at the image plane. The piezo drive velocity will be set to match the aircraft ground velocity during image collection, such that the image smear from the bolometer's long time constant is eliminated. This is critical for the use of a standard microbolometer array which typically has ~14msec time constant. Another key feature is the real-time radiometric correction that will occur during flight to account for the instrument and optics temperature changes during operation. This methodology is being utilized by DRS in commercial radiometers and will be implemented here to account for instrument/optics temperature changes and their contribution to radiometric error. This is a dramatic shift from prior radiometers built for earth observation in that those instruments typically cool the optics to reduce radiometric error. We envision a space instrument using 10 FPAs, with up to 12 spectral filters to cover a ground swath width of 310km from a 705km altitude orbit and a 100m GSD. For this airborne demo we plan to utilize 4 FPAs with 8 spectral band filters to demonstrate the key technology within the more limited IIP program budget. For an airborne demo, using 120mm EFL f/1 optics at 15,000ft altitude, will have a 0.65m GSD with two parallel swath

Image Not Available

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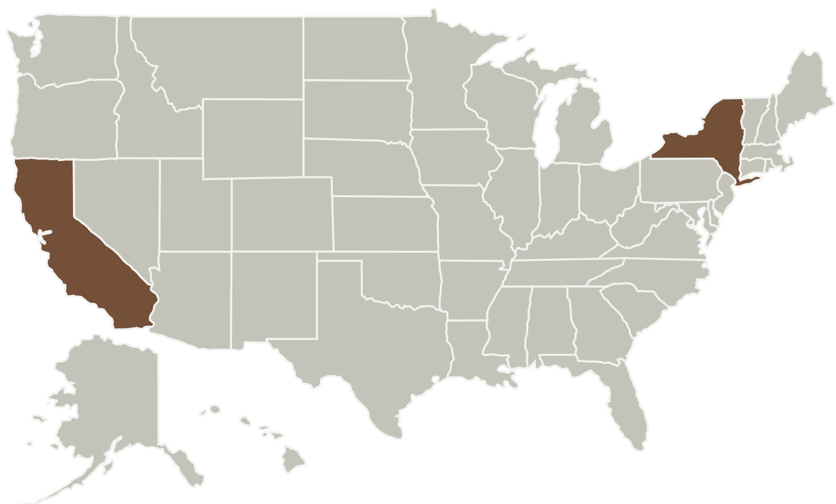
widths of 414km separated by a gap of 619m. We will show direct applicability to a space instrument and how it is easily scalable using a stagger butted array approach. Much of the same hardware could be utilized on a space version of this instrument. Period of performance of this IIP project is expected to be 36 months. The first year of the program will involve the design of the instrument hardware, the second year will be the build of the components integration and assembly of the instrument and the third year will be laboratory test of the instrument and airborne field testing. Entry level TRL for this instrument is 3; exit level TRL at the end of year 3 will be 6.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Leonardo DRS	Lead Organization	Industry	Arlington, Virginia

Primary U.S. Work Locations	
California	New York

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Organization:

Leonardo DRS

Responsible Program:

Instrument Incubator

Project Management

Program Director:

Pamela S Millar

Program Manager:

Parminder S Ghuman

Principal Investigator:

Philip A Ely

Co-Investigators:

John P Kerekes
Mark S Muzilla
Raymond E Wagoner

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Technology Maturity (TRL)

Start: **3**
Current: **3**

1	2	3	4	5	6	7	8	9
Applied Research			Development			Demo & Test		

Technology Areas

Primary:

- TX08 Sensors and Instruments
  └ TX08.1 Remote Sensing Instruments/Sensors
    └ TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

Target Destination

Earth